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P a t e n t A t t o r n e y s

REC'D 10 JUN 1999

WIPO PCT

May 10, 1999

**FACSIMILE TRANSMISSION
OF SEVEN PAGE(S)
TO: 001 703 305 3230**

CONFIRMATION

Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
U.S.A.

Attention: Ms. Diane I. Lee

Dear Ms. Lee,

**Re: PCT Application No. PCT/IL98/00543
in the name of On Track Innovations Ltd.
Our Ref: 114486-4.MM (Please quote)**

Thank you for the International Search Report dated March 30, 1999.

I am enclosing duplicate pages 5, 6, 14 and 16 wherein I have effected minor changes to the two independent claims and have conformed the consistory clauses thereto. If possible, I would like these pages to be substituted **before publication**.

Additionally, I enclose explanatory remarks relating to the principal reference cited by the Search Division.

Original substitute pages follow together with the confirmation copy of this letter by airmail.

Yours sincerely,


Jonathan Topper

JJT/

Re: PCT/IL98/00543

Comments relating to the International Search Report

The Search Division implies that Claims 1, 6 to 12, 14 and 16 to 18 are anticipated by US Patent No. 5,428,214.

Claims 2 to 5, 13 and 15 are also considered obvious by the Search Division in view of the same reference as well as US Patent Nos. 5,757,521 and 5,838,235.

At the outset, so far as the principal reference is concerned, it does not describe the same approach as discussed in the application. Whilst it does also relate to a contactless transponder in the form of a card, it describes a quite different construction to that proposed by the invention and described in the application. Thus, US Patent No. 5,428,214 discloses a contactless transponder comprising a coil antenna which is wound around a bobbin shown in exploded view in Fig. 2 of the patent. The bobbin comprises opposing end plates 10 and 11 which form the substrate of the transponder and are separated by a thin plate-shaped inner core 15 of oval shape and around which the coil antenna is wound. Note that all three components, i.e. the two end plates 10 and 11 as well as the inner core 15 are provided with a Z-shaped recess 17 for accommodating therein the electronic chip.

It is apparent from this construction that the electronic chip is a separate component to the coil antenna itself and that, in manufacture, after winding the coil antenna, the electronic chip module must be inserted into the Z-shaped recess and bonded to the ends of the coil antenna.

It is therefore apparent that the construction taught in US Patent No. 5,428,214 suffers from the same drawbacks as those other prior art references to whose solution the present invention is directed.

Coming now to the claims, it is believed that original Claim 1 was probably already distinguished over the cited reference whilst probably Claim 18 was not. Thus, Claim 1 specifically recites that the chip carrier module comprises an integrated circuit and a coil antenna connected thereto and is packaged into a discrete unit so as to be amenable to mechanical assembly of the data transaction card *without requiring additional electrical connections between the support and the chip carrier module during or subsequent to assembly* [emphasis added].

It may be argued that the construction taught by US Patent No. 5,428,214 also obviates the need for additional electrical connections between the “support” and the chip carrier module although it is believed that such a contention must be considered moot. What is certainly true is that US Patent No. 5,428,214 explicitly requires that the antenna be connected to the chip and therefore we have amended Claim 1 so that instead of reciting that no additional electrical connections are required “between the support and the chip carrier module during or subsequent to assembly” there is recited instead that no additional electrical connections are required “*between the coil antenna and the chip carrier module during or subsequent to assembly*”.

Claim 18 has been amended so that step (b) now recites explicitly that the coil antenna is electrically connected to the integrated circuit during manufacture so as to form a discrete unit which may then be mounted into the cavity of the support *without requiring additional electrical connections between the coil antenna and the chip carrier module during or subsequent to assembly* [emphasis added].

Thus, both independent Claims 1 and 18 as amended are clearly patentably distinguished over the principal prior art reference. It does not appear that the subsidiary references add anything to change this view but we will defer a detailed discussion of these references, if necessary, until Preliminary Examination.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a data transaction card constructed by assembly of the body of a card with a chip carrier module.

It is a further object of the invention to provide such a data card
5 wherein all the electronic components reside in the chip carrier module, so that no additional electrical connections are required between the coil antenna and the chip carrier module.

In accordance with a broad aspect of the invention there is provided a data transaction card having an interface for bi-directional contactless
10 communication, the data transaction card comprising:

a support having a cavity for accommodating therein a chip carrier module which comprises:

a substrate having a first side and a second side,
an integrated circuit mounted on the first side of the substrate for
15 managing functions of the data transaction card, and

a coil antenna electrically connected to the integrated circuit for inductive coupling with a remote antenna, connections to the coil antenna being accessible from the first side of the substrate;

the chip carrier module being packaged into one discrete unit so as to
20 be amenable to mechanical assembly of the data transaction card without requiring additional electrical connections between the coil antenna and the chip carrier module during or subsequent to assembly.

Preferably, the chip carrier module hosts an optical visual authentication mark, such as an encoded hologram, formed into a personalized
25 identification mark by insertion of a picture of the bearer of the card as the encoded hologram.

Preferably, the contact/contactless data transaction card further comprises a contact field for contact communication, wherein the card and the contacts are compatible with the ISO 7816 Standard for contact cards.

The contact field includes separate contacts applied on the second side of the substrate, for contact communication between the data transaction card and a card reader.

5 Preferably, the contact/contactless data transaction card is assembled by use of the conventional methods employed for the production of contact data cards.

10 In accordance with a preferred embodiment, the antenna comprises more than one winding applied either on the first or second side of the substrate. Alternatively, two antennae may be provided each on an opposite side of the substrate and having the same or a different number of windings. In such case, the two antennae behave as a parallel plate capacitor whose capacitance may be exploited to adjust an operational frequency of a tuned circuit containing the coil antennae. If desired, such tuning may be realized by an external capacitor coupled to the substrate.

15 Furthermore, it is also preferable for the windings of the coil antenna to be applied along the periphery of the substrate.

The invention also contemplates a method for manufacturing a data transaction card, method comprising the steps of:

- (a) providing a support having a cavity therein,
- 20 (b) independently producing a chip carrier module having embedded therein an integrated circuit and a coil antenna electrically connected to said integrated circuit without requiring additional electrical connections between the coil antenna and the chip carrier module during or subsequent to assembly, and
- 25 (c) mounting the chip carrier module in the cavity of the support.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

CLAIMS:

1. A data transaction card having an interface for bi-directional contactless communication, the data transaction card comprising:

5 a support (20) having a cavity (12, 22) for accommodating therein a chip carrier module (10) which comprises:

a substrate (11, 21) having a first side (45) and a second side (46),

an integrated circuit (30) mounted on the first side of the substrate for managing functions of the data transaction card, and

10 a coil antenna (40) electrically connected to the integrated circuit for inductive coupling with a remote antenna, connections to the coil antenna being accessible from the first side of the substrate;

the chip carrier module being packaged into one discrete unit so as to be amenable to mechanical assembly of the data transaction card without requiring additional electrical connections between the coil antenna and the
15 chip carrier module during or subsequent to assembly.

2. The data transaction card according to Claim 1, further comprising:

an optical visual authentication mark (16) applied to the second side of the substrate, so as to remain visible after packaging into the chip carrier module and after assembly of the chip carrier module with the support.

20 3. The data transaction card according to Claim 2, wherein the visual authentication mark is a hologram.

4. The data transaction card according to Claim 2, wherein the visual authentication mark is an encoded hologram which forms a personal identification of an authorized bearer of the data transaction card

25 5. The data transaction card according to Claim 4, wherein the encoded hologram is a picture of the authorized bearer of the data transaction card.

14. The data transaction card according to Claim 12, wherein:

the first and second coil antennae behave as a parallel plate capacitor, and

an operational frequency of the coil antennae is a function of a capacitance of said parallel plate capacitor

15. The data transaction card according to Claim 13, wherein:

the first and second coil antennae behave as a parallel plate capacitor, and

an operational frequency of the coil antennae is a function of a capacitance of said parallel plate capacitor.

16. The data transaction card according to Claim 1, wherein the coil antenna is applied along a periphery of the chip carrier module.

17. The data transaction card according to Claim 6 having an overall thickness no greater than 0.8mm

18. A method for manufacturing a data transaction card according to Claim 1, including the steps of:

(a) providing a support having a cavity therein,

(b) independently producing a chip carrier module having embedded therein an integrated circuit and a coil antenna electrically connected to said integrated circuit without requiring additional electrical connections between the coil antenna and the chip carrier module during or subsequent to assembly, and

(c) mounting the chip carrier module in the cavity of the support.

PATENT COOPERATION TREATY

PCT

**COMMUNICATION IN CASES FOR WHICH
NO OTHER FORM IS APPLICABLE**

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark
Office
Attn.: Diane I. LEE
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

Date of mailing (<i>day/month/year</i>) 11 June 1999 (11.06.99)	
Applicant's or agent's file reference 114486.4 MM	REPLY DUE see paragraph 1 below
International application No. PCT/IL98/00543	International filing date (<i>day/month/year</i>) 09 November 1998 (09.11.98)
Applicant ON TRACK INNOVATIONS LTD.	

1. ☐ REPLY DUE within _____ months/days from the above date of mailing
- ☐ NO REPLY DUE, however, see below
- ☒ IMPORTANT COMMUNICATION
- ☐ INFORMATION ONLY

2. COMMUNICATION:

Please find attached a correspondence that was apparently addressed to United States Patent and Trademark Office as International Searching Authority (ISA/US).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer R. Raissi
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING
AMENDMENTS OF THE CLAIMS(PCT Rule 62 and
Administrative Instructions, Section 417)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark
Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as International Preliminary Examining Authority

Date of mailing (day/month/year)

21 July 1999 (21.07.99)

International application No.

PCT/IL98/00543

International filing date (day/month/year)

09 November 1998 (09.11.98)

Applicant

ON TRACK INNOVATIONS LTD. et al

The International Bureau hereby informs the International Preliminary Examining Authority that no amendments under Article 19 have been received by the International Bureau (Administrative Instructions, Section 417).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

S. Mafla

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark
Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year)

21 July 1999 (21.07.99)

International application No.

PCT/IL98/00543

Applicant's or agent's file reference

114486.4 MM

International filing date (day/month/year)

09 November 1998 (09.11.98)

Priority date (day/month/year)

19 November 1997 (19.11.97)

Applicant

BASHAN, Oded et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

15 June 1999 (15.06.99)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 09 JUN 2000

Applicant's or agent's file reference 114486.4 MM	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IL98/00543	International filing date (day/month/year) 09 NOVEMBER 1998	Priority date (day/month/year) 19 NOVEMBER 1997
International Patent Classification (IPC) or national classification and IPC Please See Supplemental Sheet.		
Applicant ON TRACK INNOVATIONS LTD.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 4 sheets.
☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
 These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 15 JUNE 1999	Date of completion of this report 11 MAY 2000
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer DIANE I. LEE
Facsimile No. (703) 305-3230	Telephone No. (703) 306-3423

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/IL98/00543

I. Basis of the report

1. With regard to the elements of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
 pages _____ (See Attached) _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☒ the claims:
 pages _____ (See Attached) _____, as originally filed
 pages _____, as amended (together with any statement) under Article 19
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☒ the drawings:
 pages _____ (See Attached) _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☒ the sequence listing part of the description:
 pages _____ (See Attached) _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

- ☒ the description, pages _____ None
- ☒ the claims, Nos. _____ None
- ☒ the drawings, sheets/fig _____ None

5. ☒ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

**Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/IL98/00543

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. statement**

Novelty (N)	Claims	<u>1-18</u>	YES
	Claims	<u>None</u>	NO
Inventive Step (IS)	Claims	<u>None</u>	YES
	Claims	<u>1-18</u>	NO
Industrial Applicability (IA)	Claims	<u>1-18</u>	YES
	Claims	<u>None</u>	NO

2. citations and explanations (Rule 70.7)

Claims 1 and 6-18 lack an inventive step under PCT Article 33(3) as being obvious over Hackers et al. [US 5,428,241-referred as Hackers].

Re claims 1, 10-11, 16, and 18: Hackers discloses contactless operating electronic responding card which serves as a data transaction card comprising: a support 10, 11 having a cavity 12, 13, 17, and 33 for accommodating there a core part (14, 15, 16) as a chip carrier module which comprises: a substrate 15 having a first side and a second side (see figure 2-5), an integrated circuit 34 mounted on the first side of the substrate for managing functions of the data transaction card, and a coil antenna 32 applied on the first side and the second side of the substrate and electrically connected to the integrated circuit for inductive coupling with a remote antenna, connections to the coil antenna being accessible from the first side of the substrate.

Although Hackers shows in figures 2 and 5 the configuration showing a constitutes of the chip carrier module so as to be amenable to mechanically assembly of the data transaction card without requiring additional electrical connections between the coil and the chip carrier module during or subsequent to assembly (see col. 3, lines 10+ and figure 2), he is silent with respect to the chip carrier module being packaged into one discrete unit.

However, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to consolidate the core parts of the data transaction card as an one module, i.e., the integrated circuit and the coil antenna into one discrete unit to provide a reinforced module in the data transaction card therefore, providing Hackers with a simplified structure of the card which also less likely to damage when a mechanical stress, such as bending, is applied.

Re claims 6-9: Hackers teaches the confection pins 5. The smart card containing contact to conform with ISO stand 7816 is well known in the art.

Re claim 17: Hackers discloses the thickness of the card being not exceed 0.076mm which is in accordance with ISO standards (see col. 2, lines 60-65).

(Continued on Supplemental Sheet.)

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

CLASSIFICATION:

The International Patent Classification (IPC) and/or the National classification are as listed below:

IPC(6): G06K 19/16, 5/00, 7/10, 7/06, 7/08 and US Cl.: 235/492, 380, 439, 441, 448, 451, 457, 492; 902/25, 26

I. BASIS OF REPORT:

This report has been drawn on the basis of the description,
page(s) 1-4 and 7-13, as originally filed.
page(s) NONE, filed with the demand.
and additional amendments:
Page 5-6, filed with the letter of 20 August 1999

This report has been drawn on the basis of the claims,
page(s) 6-13, as originally filed.
page(s) NONE, as amended under Article 19.
page(s) NONE, filed with the demand.
and additional amendments:
1-5 and 14-18 filed with the letter of 20 August 1999

This report has been drawn on the basis of the drawings,
page(s) 1-3, as originally filed.
page(s) NONE, filed with the demand.
and additional amendments:
NONE

This report has been drawn on the basis of the sequence listing part of the description:
page(s) NONE, as originally filed.
pages(s) NONE, filed with the demand.
and additional amendments:
NONE

5. (Some) amendments are considered to go beyond the disclosure as filed:
NONE

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):

Re claims 12-15: Hackers teaches different coil construction of the antenna coils constructed within a coil bobbin (see figures 1a-1f). Wherein the coil antenna would behave as a parallel plate capacity.

Claims 2-5 lack an inventive step under PCT Article 33(3) as being obvious over Hackers in view of Walters et al [US 5,757,521-referred as Walters]. The teachings of Hackers have been discussed above.

Hackers fails to teach the optical visual authentication mark applied to the second side of the substrate, so as to remain visible after packaging into the chip carrier module and after assembly of the chip carrier module with the support.

Walters discloses a security device having a grid screen metallization pattern may be laid down over a hologram or diffraction grating formed as a surface relief pattern on a substrate to form a visually identifiable so as to remain visible after packaging (see the abstract and figures 1-4).

In view of Walters teaching, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to incorporate the teachings of hologram as taught by Walters in order to provide Hackers with more secure and anti-counterfeiting components.

----- NEW CITATIONS -----

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G06K 19/16, 5/00, 7/10, 7/06, 7/08	A1	(11) International Publication Number: WO 99/26197 (43) International Publication Date: 27 May 1999 (27.05.99)
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(21) International Application Number: PCT/IL98/00543

(22) International Filing Date: 9 November 1998 (09.11.98)

(30) Priority Data:
122250 19 November 1997 (19.11.97) IL

(71) Applicant (for all designated States except US): ON TRACK INNOVATIONS LTD. [IL/IL]; Z.H.R. Industrial Zone, P.O. Box 32, 12000 Rosh Pina (IL).

(72) Inventors; and

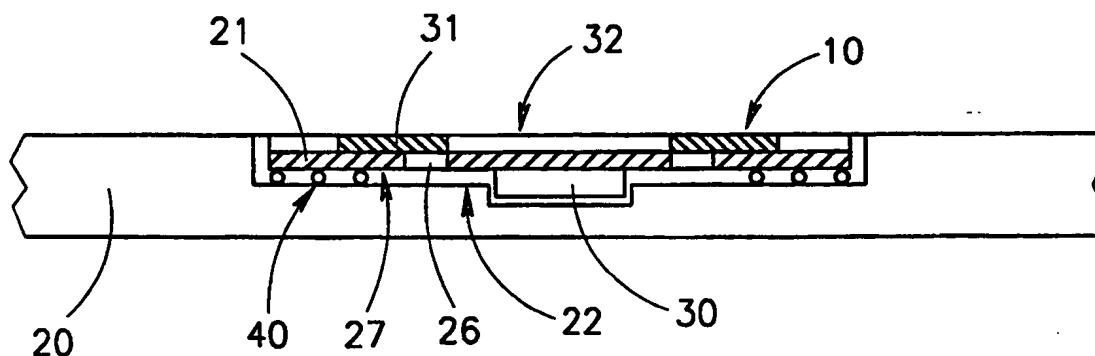
(75) Inventors/Applicants (for US only): BASHAN, Oded [IL/IL]; Ramim Street 45, 21801 Carmiel (IL). ITAY, Nehemya [IL/IL]; Kibbutz Kfar Giladi, 12210 Kfar Giladi (IL). GILBOA, Ronnie [IL/IL]; Moshav Beit Hillel, 12255 Beit Hillel (IL). ADUK, Moshe [IL/IL]; Korazim 43, 12391 Korazim (IL).

(74) Agent: REINHOLD COHN AND PARTNERS; P.O. Box 4060, 61040 Tel Aviv (IL).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published*With international search report.**Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: DATA TRANSACTION CARD AND METHOD OF MANUFACTURE THEREOF

**(57) Abstract**

A data transaction card having an interface for bi-directional contactless communication, and comprising a support (20) having a cavity (12) for accommodating therein a chip carrier module (10). The chip carrier module comprises a substrate (11) having a first side (45) and a second side (46), and an integrated circuit (30) mounted on the first side of the substrate for managing functions of the data transaction card. A coil antenna (40) is electrically connected to the integrated circuit for inductive coupling with a remote antenna, connections to the coil antenna being accessible from the first side of the substrate. The chip carrier module is packaged into one discrete unit so as to be amenable to mechanical assembly of the data transaction card without requiring additional electrical connections between the support and the chip carrier module during or subsequent to assembly. Such a construction allows for efficient mass-production of the data transaction card.

FOR THE PURPOSES OF INFORMATION ONLY

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DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

Data transaction card and method of manufacture thereof

FIELD OF THE INVENTION

The invention relates to a bi-directional communication data transaction card with an onboard processor for effecting both "contact" and "contactless" modes of data transfer.

5

BACKGROUND OF THE INVENTION

Both "contact" and "contactless" bi-directional communication data transaction cards are known *per se*. A concise introduction to the nomenclature and principal features of data transaction cards, also called data
10 cards or smart cards, is found in an IEEE Conference Paper by Klaus Vedder, The Hague, 4-8 May 1992, hereinafter referred to as Vedder. Another general overview is given by Gilles Lisimaque in a paper called "Smart Cards" delivered at the 27th. International SAMPE Technical Conference, October 9-12, 1995. Smart cards represent a specific imple-
15 mentation of chip cards wherein the chip is a microcomputer having a programmable memory.

Generally, such smart cards are provided either with electrical contacts for effecting direct electrical contact with a card reader, or with an antenna coil for effecting contactless bi-directional communication with a
20 remote card reader. U.S. Patent No. 5,206,495 for a Chip Card in the name of H. D. Kreft discloses a chip card allowing both contact and contactless communication in a single smart card.

A principal object of U.S. Patent. 5,206,495 is the provision of a chip card including both a contact field and transmission coils and a switching element device coupled between both and a semiconductor device such as a microcomputer.

5 International Patent Publication No. WO 98/29830, in the name of the present applicant, discloses a contact/contactless data transaction card which automatically conforms to a required communication mode in accordance with whether data is received via the antenna or via the contacts.

10 Contactless smart cards are particularly suited for applications, such as mass transport systems, wherein data communication must be effected very quickly without imposing the overhead incurred in manually introducing the smart card into the slot of a card reader.

Common to all such smart cards is an on-board microcomputer
15 including a memory and processing capability for effecting the desired bi-directional data transmission and data storage. In the case where "contact" data transmission is required, there is provided a so-called "contact field" having a plurality of contacts, each of which is connected to the microcomputer by means of a respective electrical connection. Data
20 transmission with an external reader is then effected by inserting the card into a suitable reader having a spring-loaded contacts which bear on the respective contacts in the contact field of the chip card.

Alternatively, when contactless data transmission is required, an antenna coil in the chip card is adapted to receive data from and transmit
25 data to a reading device having a similar antenna.

Sometimes, such contact/contactless cards are called hybrid cards. These cards are thus packaged, with at least, components such as contacts, a microcomputer and an antenna.

As smart cards are presently mass-produced by the hundreds of millions, the assembly of the components and their embedding and packaging into the cards must be performed by fast and cost-effective processes. For purposes of compatibility, international standards govern the smart card industry. Thus, the dimensions and the location of the contacts of smart cards are laid down by Part 2 of the International Standard ISO 7816. The card itself, known as "standard identification card" or "ID-1 card", is the size of a regular credit card. The thickness of the card is approximately 0.8 mm.

10 The ISO 7816 standard defines eight contacts, in two columns of four, but typically, only five or six are put to use. The other two or three are reserved for future utilization and therefore often not provided. Each single contact measures at least 2 x 1.7 mm. The eight contacts of the contact field are contained in a square of about 10 x 10 mm, thus covering an area of about 1 cm². Fig. 1a provides the minimum dimensions of the contacts, their arrangement and their location in the upper left corner of a card, as dictated by the ISO 7816 standard. Fig. 1b gives an example of a contact field with an eight contact layout. The microcomputer or integrated circuit used in a data transaction card is usually integrated on to a single piece of silicon.

15 20 The size of a chip generally only extends from some 1 mm² to 16 mm², with a thickness ranging from 0.1 to 0.2 mm.

Typically, the antenna coil is wound around the periphery of the card, thus having dimensions approximately equal to those of the card and being very much greater than those of the contact field. As a result, the contacts induce no deleterious effect on the operability of the antenna coil.

25 This, however, is not the case when the antenna coil is reduced in size so as to allow for its mounting directly on the integrated circuit. In such case, the close proximity of the mass of metal constituted by the contact field to the antenna coil, can interfere with its operability.

Different designs have been devised for the assembly of the many components of a smart card into a finished product. For example, U.S. Patent 5,589,032 in the name of J-C. Fidalgo provides a bi-directional contact and contactless communication card. Fidalgo describes all the necessary components and suggests ways to facilitate their assembly, their electrical connection and their final integration. Nevertheless, the assembly still requires the laborious addition of components both in the body of the card 2, as well as in the electronic module 7. For example, the antenna 5 is embedded in the body of the card 2 and must be connected to the chip 8 which is itself part of the electronic module 7. Thus the different discrete components must be electrically interconnected. Thus, the card described by Fidalgo is not based on modular building blocks which are amenable for mass assembly.

To alleviate the difficulties encountered with the assembly and connection of the antenna, German Patent No. 37 21 822, in the name of K. Sickert, proposes forming the coil antenna 4 on to the semiconductor of the Integrated Circuit 5, around the active surface of the semiconductor and along its borders. Such a scheme allows the antenna to be provided during the manufacture of the integrated circuit and thus obviates the need electrically to connect the antenna to the integrated circuit in an independent subsequent stage of assembly. However, Sickert limits his invention to the antenna-chip pair and does not deal with further components. Also, since the size of the antenna is necessarily limited by the dimensions of the semiconductor wafer, the transmission range is short.

In International Patent Publication No. WO 96/35190, to Reiner, there is suggested a method for contactless inductive coupling of a small antenna to a larger one. As an improvement upon Sickert, a small antenna, along the edges of a substrate, is inductively coupled to a larger antenna, disposed along the edges of the card itself.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a data transaction card constructed by assembly of the body of a card with a chip carrier module.

It is a further object of the invention to provide such a data card
5 wherein all the electronic components reside in the chip carrier module, so that no additional electrical connections are required between the card and the chip carrier module.

In accordance with a broad aspect of the invention there is provided a data transaction card having an interface for bi-directional contactless
10 communication, the data transaction card comprising:

- a support having a cavity for accommodating therein a chip carrier module which comprises:

- a substrate having a first side and a second side,
 - an integrated circuit mounted on the first side of the substrate for
15 managing functions of the data transaction card, and

- a coil antenna electrically connected to the integrated circuit for inductive coupling with a remote antenna, connections to the coil antenna being accessible from the first side of the substrate;

- the chip carrier module being packaged into one discrete unit so as to
20 be amenable to mechanical assembly of the data transaction card without requiring additional electrical connections between the support and the chip carrier module during or subsequent to assembly.

Preferably, the chip carrier module hosts an optical visual authentication mark, such as an encoded hologram, formed into a personalized
25 identification mark by insertion of a picture of the bearer of the card as the encoded hologram.

Preferably, the contact/contactless data transaction card further comprises a contact field for contact communication, wherein the card and the contacts are compatible with the ISO 7816 Standard for contact cards.

The contact field includes separate contacts applied on the second side of the substrate, for contact communication between the data transaction card and a card reader.

5 Preferably, the contact/contactless data transaction card is assembled by use of the conventional methods employed for the production of contact data cards.

10 In accordance with a preferred embodiment, the antenna comprises more than one winding applied either on the first or second side of the substrate. Alternatively, two antennae may be provided each on an opposite side of the substrate and having the same or a different number of windings. In such case, the two antennae behave as a parallel plate capacitor whose capacitance may be exploited to adjust an operational frequency of a tuned circuit containing the coil antennae. If desired, such tuning may be realized by an external capacitor coupled to the substrate.

15 Furthermore, it is also preferable for the windings of the coil antenna to be applied along the periphery of the substrate.

The invention also contemplates a method for manufacturing a data transaction card, method comprising the steps of:

- (a) providing a support having a cavity therein,
- 20 (b) independently producing a chip carrier module having embedded therein an integrated circuit and a coil antenna electrically connected to said integrated circuit, and
- (c) mounting the chip carrier module in the cavity of the support.

25 BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how the same may be carried out in practice, some preferred embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1a shows some of the standard dimensions for known contact data communication cards, as dictated by the ISO 7816;

Fig. 1b shows an example of a known contact field with an eight contact layout, as used for contact data communication cards;

5 **Fig. 2** shows schematically a cross-section of a contactless data communication cards according to a first embodiment of the invention;

Fig. 3 shows schematically a lower plan view of a substrate for a contactless data communication card according to the invention;

10 **Fig. 4** shows schematically a cross-section of a contactless data communication card in accordance with of a second embodiment of the invention conforming to the layout depicted in Fig. 2;

Fig. 5 shows schematically a cross-section of a contact and contactless data communication card in accordance with a third embodiment of the invention;

15 **Fig. 6** shows schematically a lower plan view of a substrate for the contact and contactless data communication card illustrated in Fig. 5; and

Fig. 7 shows schematically the contact and contactless data communication card shown in Fig. 5 in accordance with a fourth embodiment of the invention.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 2 shows a cross-section of a data card according to the present invention having a communications interface for allowing a contactless mode of bi-directional data transmission. The data card includes a chip
25 carrier module 10 having a substrate 11 which is retained in a cavity 12 of a support medium depicted generally as 20.

The substrate 11 provides a foundation for the various components of the card such as an integrated circuit 30 and a coil antenna 40 which are mounted on a lower surface 45 of the substrate 11 (constituting a first side

thereof). The integrated circuit 30 manages the various command and control functions of the data transaction card. The coil antenna 40 is likewise formed on the lower side 45 of the substrate 11 around the integrated circuit 30. It is understood that the substrate 11 is a Printed
5 Circuit Board (PCB) on to which the antenna 40 may be etched in known manner. The antenna 40 may also be applied on to the lower side 45 of the substrate 11 by other means, such as deposition, or wires and the like. The leads of the antenna 40 terminate with conductive pads (not shown), by means of which the antenna 40 may be connected to the integrated circuit
10 30 as will be explained in greater detail below. During a subsequent stage of manufacture following formation of the coil antenna 40, the integrated circuit 30 is mounted on to the lower side 45 of the substrate 11 and secured thereto. The coil antenna 40 may have one or more turns, in a single or multiple layers, according to the requirements for inductive coupling
15 communication between the data card and a suitable remote card reading device.

Fig. 3 is a plan view of the lower surface 45 of the substrate 11, showing the antenna 40 electrically connected to the integrated circuit 30 by two wire leads 17. The electrical connections may be performed by wire
20 bonding or any suitable technique. The next step in the production process calls for the sealing of the connections, a method well known in the trade. The substrate 11 together with the associated components and the antenna 40, now packaged into a single discrete unit, constitutes the chip carrier module 10, ready for integration with the support 20 forming the body of
25 data transaction card by mechanical assembly, without requiring any further electrical connections.

The chip carrier module 10 is thus inserted in the cavity 12 until a shoulder 14 of the substrate 11 abuts a corresponding shoulder of the card, thereby bringing the upper side of both card 20 and the chip carrier module

10 flush with each other. The chip carrier module 10 is retained within the cavity 12 by gluing or other processes, according to the finishing steps known in the trade.

Fig. 4 shows an optically encoded visual authentication mark 16 which is now applied to an upper surface 46 of the substrate 11 (constituting a second side thereof). The visual authentication mark 16 may be realized as a hologram or an encoded hologram and allows form visible inspection from the outer surface of the card. The visual authentication mark 16 may serve as a personal identification relating to a bearer of the data card. For example, an encoded hologram with the picture of the proprietor of the data card permits simple visual inspection of the authorized owner.

As also seen in Fig. 4, the visual mark 16 is applied to the substrate 11 and assembled in the chip carrier module 10. The assembly process of the chip carrier module 10 comprises the additional step of securing or inscribing the visual mark 16 on to the substrate 11. If the thickness of the visual mark 16 is not negligible, then account must be taken therefor either by making the substrate 11 thinner or by deepening the cavity 12, in order that the overall thickness of the card conforms to the requisite standards. This is of particular importance when the data card is also provided with a contact field for insertion into a slot of an external card reader, since the slot is dimensioned to accept only such data cards as meet the requisite standards.

Fig. 5 shows in cross-section an application of the invention to a data card still having both a contactless interface and a contact field whilst still obviating the need for effecting supplementary electrical interconnections during assembly. To the extent that many of the components in the contact/contactless card are the same as in the contactless card described above, identical reference numerals will be employed.

The support medium 20 of the card supports a chip carrier module 10 retained in a cavity 22 of the card, and which is complementary in shape to the chip carrier module 10. The chip carrier module 10 comprises the substrate 21 on which the various components of the card are mounted. The substrate 21 has a lower surface (constituting a first side), for accommodating therein an integrated circuit 30. As will be explained in greater detail below, the substrate 21 is also provided with several via holes 26 connecting between the lower surface of the substrate to an upper surface thereof (constituting a second side). The substrate 21 further has shoulders 27 for mating with corresponding shoulders in the support medium 20 of the card.

The substrate 21 is produced by any of the well-known Printed Circuit Board manufacturing techniques which provide for the necessary conductors and via holes. The via holes 26 allow for the electrical connection of a coil antenna 40 on the lower surface of the substrate 21 to respective contacts 31 of a contact field on the upper surface of the substrate 21, as will now be explained in greater detail.

The first step of the assembly process requires that the substrate 21 be fitted on the lower surface with a coil antenna 40, applied on the flat area of the shoulders 27. The coil antenna 40 allows for inductive coupling communication with an appropriate remote antenna in a card reader (not shown). The coil antenna 40 may have one or more turns, as well as more than one layer, according to the particular implementation for which the card is intended. To facilitate the electrical connection of the coil antenna 40 to the integrated circuit 30 in later production steps, the ends of the antenna 40 terminate in conductive pads (not shown in Fig. 5), suitably located in the proximity of the integrated circuit.

The first step of the assembly process requires that there be applied to the upper surface of the substrate 21 the contact field including up to

eight separate contacts, some of which may be redundant in specific applications. The emplacement and the size of the contact field on the support medium 20, as well as the size and configuration of the separate contacts, are preferably in accordance with ISO 7816. The via holes 26, which are located, in this example, surrounding the integrated circuit 30, are also aligned with, and electrically connected to, the separate contacts 31. By such means, the coil antenna 40 may be connected to the contact field 32 even though they are on opposite sides of the integrated circuit 30. The contact field is dimensioned so as to increase the effectiveness of the coil antenna 40. Specifically the size of the contacts 31 is minimized so that the resulting mass of metal does not interfere with the operability of the coil antenna 40.

Fig. 6 shows in plan view the lower surface of the substrate 21 illustrating the assembly of the chip carrier module 10. First, the coil antenna 40 is applied to the lower surface of the substrate 21 underneath the shoulders 27 which are provided along the edges of the substrate 21. The ends of the coil antenna 40 on the shoulders 27 are connected through conductive leads, to pads (not shown) in the vicinity of the integrated circuit 30, for connection thereto by wire bonding 17. The contact field having six separate contacts 31 (shown in Fig. 5) is now applied to the upper surface of the substrate 21.

This having been done, the integrated circuit 30 is located and secured on the lower surface of the substrate 21, whereupon the integrated circuit 30 is electrically connected to the contacts 31 and to the antenna 40 by electrical wire connections 17, using wire bonding. Wire bonds are thus routed on the lower surface of the substrate 21, from the integrated circuit 30 to the two end pads (not shown) of the coil antenna 40. From there, they are routed to the corresponding via holes, connecting from the lower surface to the upper surface of the substrate 21, so as to make electrical contact

with the separate contacts 31 residing on the upper surface of the substrate. Finally, the substrate 21 is encapsulated using known techniques so that the resulting chip carrier module 10 is amenable to machine assembly without demand for further electrical connections. The chip carrier module 21 is
5 mounted on to the support medium 20 until the shoulders 27 of the substrate 20 abut a corresponding shoulder of the support medium, thereby bringing the upper side of both card and module flush with each other. The spatial disposition of the cavity 22 relative to the support medium 20 as well as the dimensions and separation of the individual contacts are selected so that the
10 contact field conforms to ISO 7816.

Fig. 7 shows schematically the lower surface of the substrate 21 with the coil antenna 40 mounted on a peripheral shoulder 27 thereof. Likewise, a second coil antenna 41 connected in series with the first coil antenna 40, is mounted on the upper surface of the substrate 21. The integrated circuit
15 30 is wire-bonded to the first end of the first coil antenna 40, on the lower surface of the substrate 21. The second end of the first coil antenna 40 is connected via a first plated through hole 42 to the first end of the second coil antenna 41 (shown in dotted outline) located on the upper surface of the substrate. Likewise, the second end of the second coil antenna 41, also
20 on the upper surface of substrate 21, is connected via a second plated through hole 43 which itself is wire bonded to the integrated circuit 30. Such a double antenna provides an augmented captive area and thus achieves enhanced communication performance.

It is also possible to exploit the capacitance inherent between the two
25 coil antennae 40 which behave as a parallel plate capacitor to tune the chip carrier module 10 to a desired working frequency, such as the resonant frequency of a data reader antenna. The operational frequency of the coil antennae is a function of the capacitance between the two coils. This avoids the separate connection to a discrete capacitor thereby reducing the bulk of

the tuned circuit. Nevertheless, if desired, an additional external capacitor may be connected to the chip carrier module 10, in order to provide for the necessary tuning.

5 Whilst a preferred embodiment of the invention has been described in detail, it is apparent that many modifications and variations thereto are possible, all of which fall within the true spirit and scope of the invention. For example, if desired the integrated circuit 30 may be offset relative to the middle of the substrate 21. Also, other configurations are possible for the coil antenna 40 which may be adapted to suit microwave transmission.

CLAIMS:

1. A data transaction card having an interface for bi-directional contactless communication, the data transaction card comprising:
 - a support (20) having a cavity (12, 22) for accommodating therein a
 - 5 chip carrier module (10) which comprises:
 - a substrate (11, 21) having a first side (45) and a second side (46),
 - an integrated circuit (30) mounted on the first side of the substrate for managing functions of the data transaction card, and
 - a coil antenna (40) electrically connected to the integrated circuit for
 - 10 inductive coupling with a remote antenna, connections to the coil antenna being accessible from the first side of the substrate;
 - the chip carrier module being packaged into one discrete unit so as to be amenable to mechanical assembly of the data transaction card without requiring additional electrical connections between the support and the chip
 - 15 carrier module during or subsequent to assembly.
2. The data transaction card according to Claim 1, further comprising:
 - an optical visual authentication mark (16) applied to the second side
 - of the substrate, so as to remain visible after packaging into the chip carrier module and after assembly of the chip carrier module with the support.
- 20 3. The data transaction card according to Claim 2, wherein the visual authentication mark is a hologram.
4. The data transaction card according to Claim 2, wherein the visual authentication mark is an encoded hologram which forms a personal identification of an authorized bearer of the data transaction card.
- 25 5. The data transaction card according to Claim 4, wherein the encoded hologram is a picture of the authorized bearer of the data transaction card.

6. The data transaction card according to Claim 1, wherein the substrate (11) further comprises:

5 a contact field with separate contacts (31) applied on the second side of the substrate, for contact communication between the data transaction card and a card reader.

7. The data transaction card according to Claim 6, wherein the contact field conforms to ISO 7816.

8. The data transaction card according to Claim 6, wherein:

10 the cavity (22) is spatially disposed relative to the support so that when the chip carrier module (10) is assembled on to the support (20), the contact field conforms to ISO 7816.

9. The data transaction card according to any one of Claims 6 to 8, wherein contact field is dimensioned so as to increase the effectiveness of the coil antenna.

15 10. The data transaction card according to Claim 1, wherein the coil antenna (40) is applied on the first side (45) of the substrate (11).

11. The data transaction card according to Claim 1, wherein the coil antenna (40) is applied on to the second side of the substrate (22), and is connected to the integrated circuit (30) by electrical interconnections (26)
20 passing from the first side of the substrate to the second side thereof.

12. The data transaction card according to Claim 10, further comprising:

25 a second coil antenna (41) mounted on the second side of the substrate and being connected to the first coil antenna (40) and to the integrated circuit (30) by electrical interconnections (43) passing from the first side of the substrate to the second side thereof.

13. The data transaction card according to Claim 12, wherein the first and second coil antennae are provided each with a different number of windings.

14. The data transaction card according to Claim 12, wherein:
the first and second coil antennae behave as a parallel plate capacitor, and
an operational frequency of the coil antennae is a function of a capacitance of said parallel plate capacitor.
- 5 15. The data transaction card according to Claim 13, wherein:
the first and second coil antennae behave as a parallel plate capacitor, and
an operational frequency of the coil antennae is a function of a capacitance of said parallel plate capacitor.
- 10 16. The data transaction card according to Claim 1, wherein the coil antenna is applied along a periphery of the chip carrier module.
17. The data transaction card according to Claim 6 having an overall thickness no greater than 0.8mm.
- 15 18. A method for manufacturing a data transaction card according to Claim 1, including the steps of:
- (a) providing a support having a cavity therein,
 - (b) independently producing a chip carrier module having embedded therein an integrated circuit and a coil antenna electrically connected to said integrated circuit, and
 - (c) mounting the chip carrier module in the cavity of said support.
- 20

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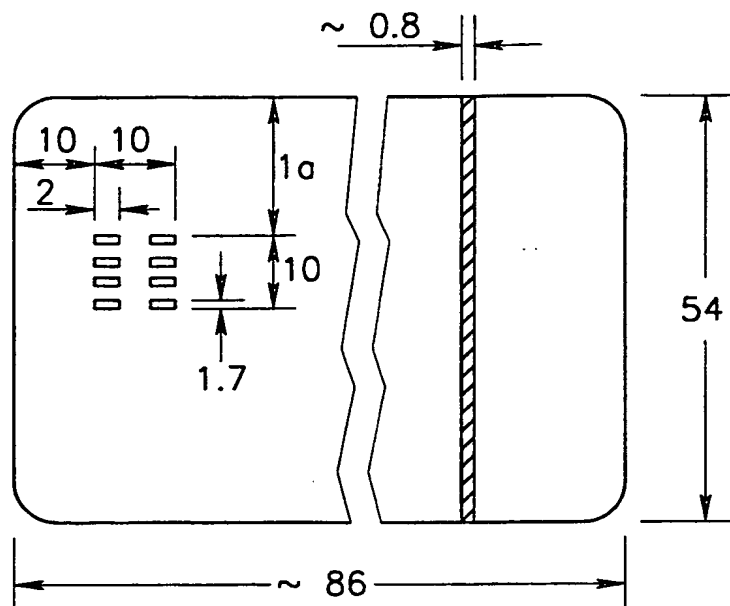


FIG. 1A

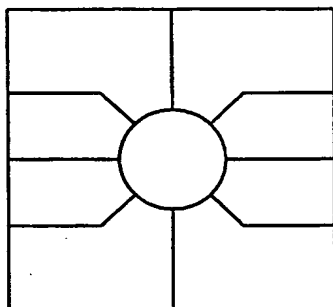


FIG. 1B

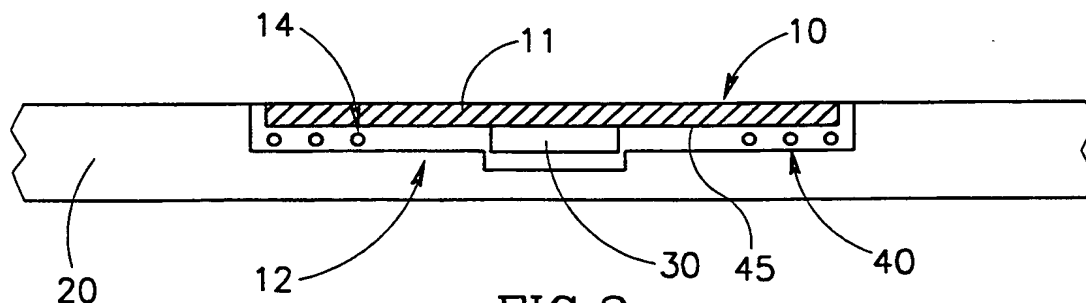


FIG. 2

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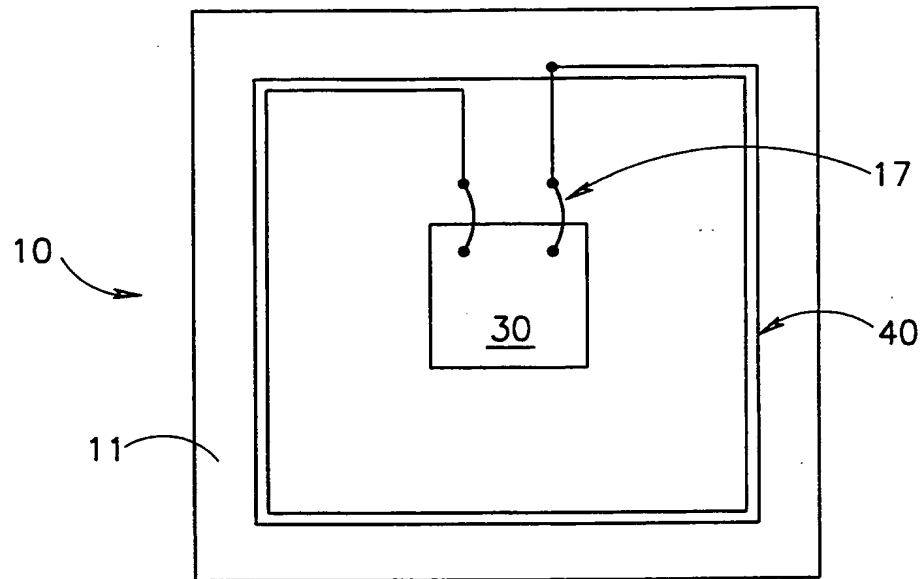


FIG. 3

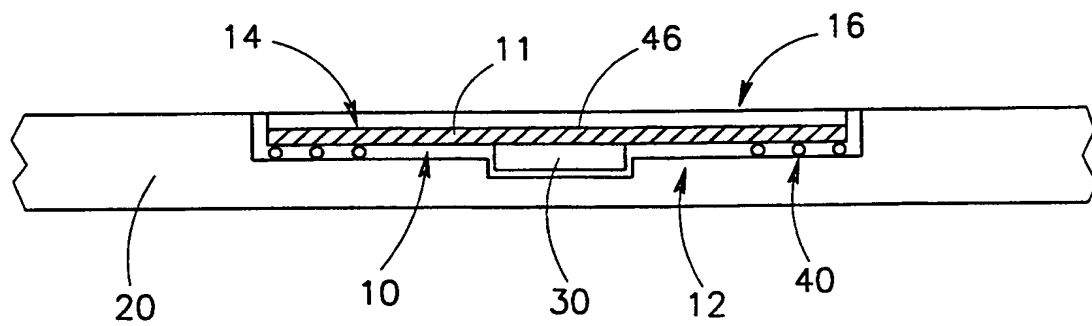


FIG. 4

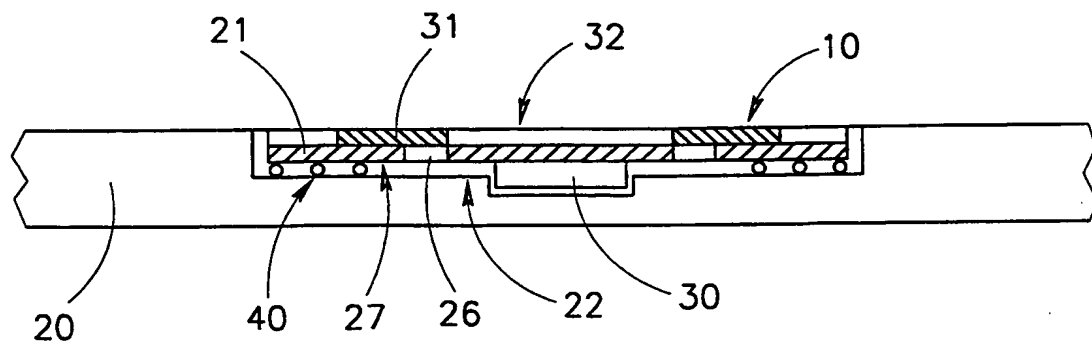


FIG. 5

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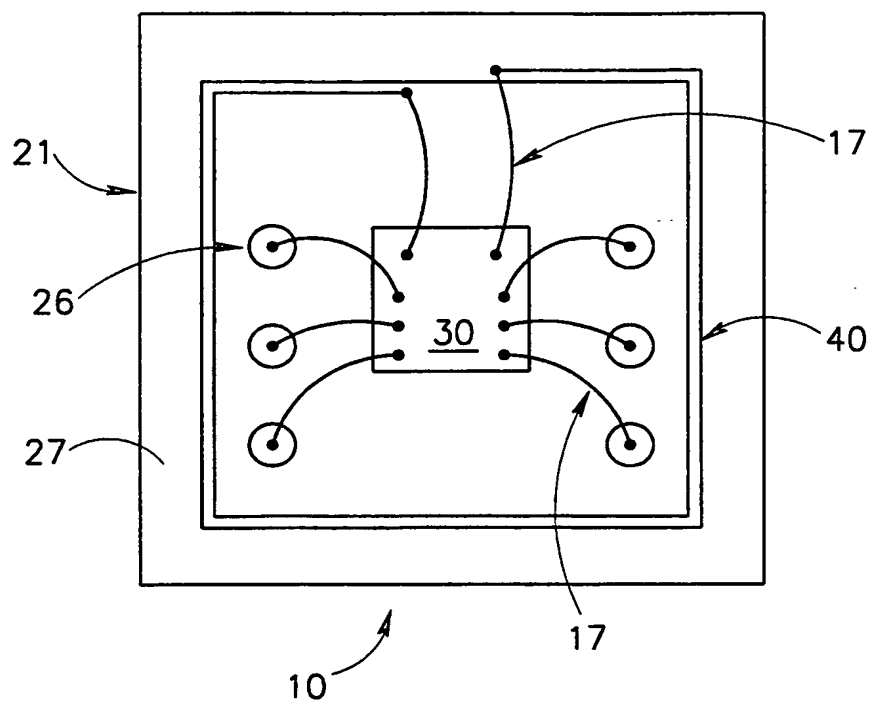


FIG. 6

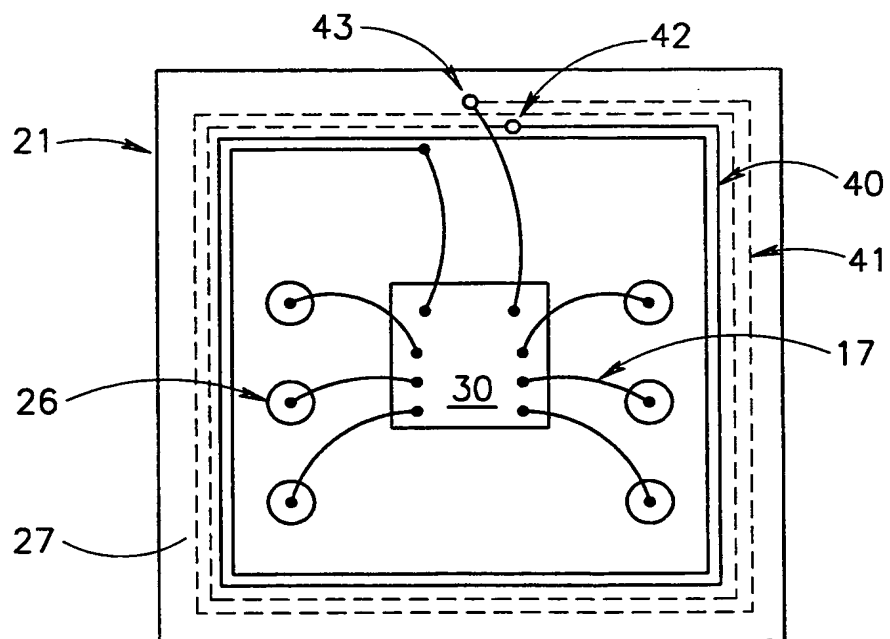


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL98/00543

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G06K 19/16, 5/00, 7/10, 7/06, 7/08
US CL : 235/492, 380, 439, 441, 448, 451, 457, 492; 902/25, 26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 235/492, 380, 439, 441, 448, 451, 457, 492; 902/25, 26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,428,214 A (HARKKERS et al.) 27 June 1995 (27/06/95), col. 2, line 2- col. 4, line 65.	1, 6-12, 14, and 16-18 ----- 2-5, 13, and 15
Y	US 5,757,521 A (WALTERS et al.) 26 May 1998 (26/05/98), col. 1, lines 15-50.	2-5
Y	US 5,838,235 A (THORIGNE) 17 November 1998 (17/11/98), col. 7, lines 44-57.	13 and 15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

05 FEBRUARY 1999

Date of mailing of the international search report

30 MAR 1999

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL98/00543

B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

APS (US PTO)

search terms: (IC or substrate# or electronic or smart or memory) (3a) (card# or medium#)

antenna#, contact#, connector#, contactless, (support? or hous### or hold###), (coil (5a) antenna#), (bidirection### or
ominidirect###), (hologram or mark### or picture# or image)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL98/00543

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G06K 19/16, 5/00, 7/10, 7/06, 7/08

US CL : 235/492, 380, 439, 441, 448, 451, 457, 492; 902/25, 26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 235/492, 380, 439, 441, 448, 451, 457, 492; 902/25, 26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

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AB X — Y	US 5,428,214 A (HARKKERS et al.) 27 June 1995 (27/06/95), col. 2, line 2- col. 4, line 65.	1, 6-12, 14, and 16-18 2-5, 13, and 15
AC Y	US 5,757,521 A (WALTERS et al.) 26 May 1998 (26/05/98), col. 1, lines 15-50.	2-5
AD Y	US 5,838,235 A (THORIGNE) 17 November 1998 (17/11/98), col. 7, lines 44-57.	13 and 15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

05 FEBRUARY 1999

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30 MAR 1999

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Washington, D.C. 20231

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B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

APS (US PTO)

search terms: (IC or substrate# or electronic or smart or memory) (3a) (card# or medium#)

antenna#, contact#, connector#, contactless, (support? or hous### or hold###), (coil (5a) antenna#), (bidirection### or omnidirect###), (hologram or mark### or picture# or image)